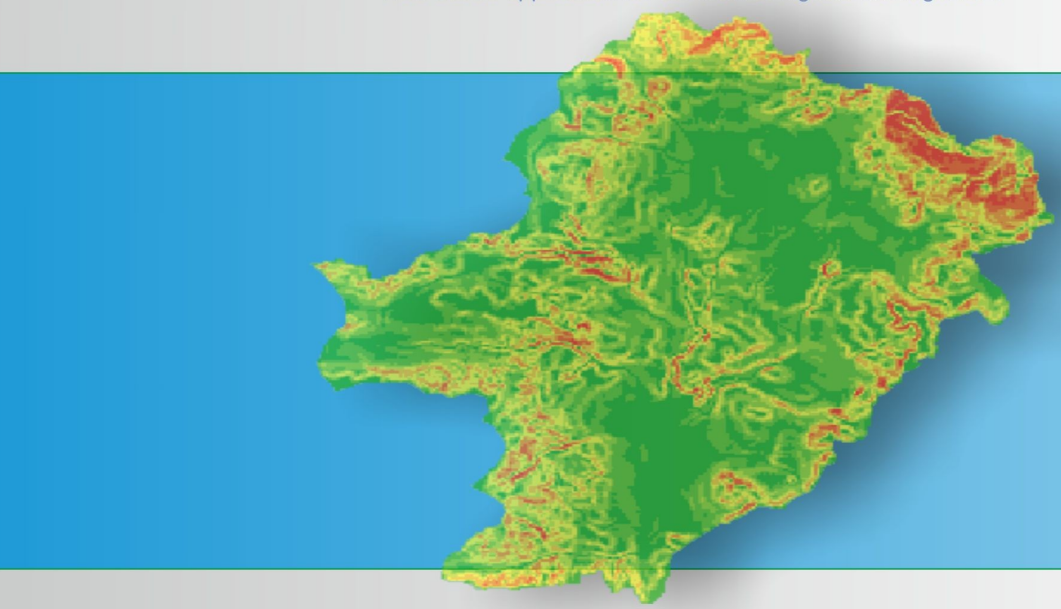
SOILPRO

SMS Application

Soil Monitoring Software

Web based application for soil monitoring and management



Soil Monitoring

Soil Management

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Preface

SMS is a web based application SMS (**S**oil **M**onitoring **S**oftware) and was developed by EKPA in collaboration with CRA ABP. The application supports all critical functions required for soil monitoring and management, based on the soil monitoring methodology developed by CRA ABP. The use of Information Technology and the web environment renders the aforementioned methodology fully operational at the level of Local and Regional Authorities (LRAs).

In order to provide effective user support services, EKPA has cooperated with CRA ABP to produce this user's manual. This manual will contain information and instructions for the use of the application, but also provides an analysis of customization needs along with the description of the processes required for adding on the application new monitoring features, based on the specific characteristics of the application area (e.g. new monitoring objects such as new thematic layers, like, for instance, vegetation types; new monitoring procedures, such as the use of aerial photography, etc.). In the first part, the User Manual provides information on the use of SMS application. In the second part a detailed section provides information for each model related to soil monitoring and management.

The web application is linked with the project's web portal, which is designed as a facilitator of several other project activities, such as the internal communication of project partners and the training application (e-course).

System Requirements

SMS is a Web based application. The User side (client) requires a web browser. The User) side web application is designed for Microsoft Internet Explorer 6.0 or higher and Mozilla Firefox 2.0 or higher or Google Chrome. All browsers are available for free. Additional web browsers may work, but have not been tested and are not supported. Your computer should also meet the minimum system requirements provided by the manufacturer of the browser you are using.

The web application will perform best on computers with a high-speed internet connection similar to digital subscriber line (DSL), cable, or faster. It is not recommended for computers using dial-up modem based internet connections.

Base Maps

SMS uses standard Google Maps as base map information. Google Maps compiles base layer imagery from satellite and aerial photography data sources. As sources range from one to three years old, there is some variation in quality of images and

some areas may appear blurry, discolored, or covered in clouds. Generally, there is high-resolution imagery for populated areas. Some remote areas, however, have high-level detail, while some urban centers do not, depending on the availability of images. Zooming in and out increases or decreases the level of feature details on a landscape. Where data are out of date, some feature details, including villages and small roads, may be missing or spatially inaccurate. Google Maps uses a Layers feature to superimpose details of interest, for example Roads, Borders, Populated Places, Terrain, etc., onto base imagery.

Google Maps is a web mapping service application and technology provided by Google, free (for non-commercial use), that powers many map-based services, including the Google Maps website, Google Ride Finder, Google Transit and maps embedded on third-party websites via the Google Maps API. Google Maps satellite images are not in real time; they are several months or years old.

Google Maps uses a close variant of the Mercator projection, so it cannot show areas around the poles. A related product is Google Earth, a stand-alone program which offers more globe-viewing features, including showing polar areas.

Part A: Use of SMS Application

In Part A of the User Manual user can find a detailed description of the SMS application. SMS application is a Web application designed to provide support to Local Authorities and soil users with minimum IT knowledge and limited support. SMS is a shell application able to host almost any soil monitoring or soil management procedure. In order to succeed this SMS development team designed SMS based on GRASS GIS software an open source GIS application. SMS takes advantage of the rich functionality of Grass GIS and delivers this functionality over the WEB. SMS's architecture is modular. The basic modules include the data handling module, the data repository, soil management – monitoring modules and mapping module. The application is based on the functionality of GRASS GIS and through a communication channel allows users to communicate with the core GIS software through predefined models or through new scripts.

Structure of SMS databases.

SMS database is based on GRASS GIS data structure, modified in order to communicate with the web interface. All data are stored in a directory referred to as a database located on the web server. This directory has to be created on the server by the database administrator. Within this database, projects are organized by project areas stored in subdirectories called locations. A location is defined by its coordinate system, map projection and geographical boundaries. Each location can have several mapsets.

When creating a new location, GRASS automatically creates a special mapset called PERMANENT where the core data for the project can be stored. Data in the PERMANENT mapset can only be added, modied or removed by the owner of the PERMANENT mapset, however, they can be accessed, analyzed, and copied into their own mapset by the other users. The PERMANENT mapset is useful for providing general spatial data (e.g. an elevation model), accessible but write-protected to all users who are working in the same location as the database owner. To manipulate or add data to PERMANENT, the owner would start GRASS and choose the relevant location and the PERMANENT mapset. This mapset also contains the DEFAULT_WIND file, which holds the default region boundary coordinate values for the location (which all users will inherit when they start using the database). Additionally, a WIND file is kept in all mapsets for storing the current boundary coordinate values and the currently selected raster resolution. Only the Database Administrator have the option of switching back to the default region at any time.

In the databases all data are stored in the local coordinate system. For example for the Peloponnesus Region all data are in EGSA87 coordinate system. SMS reprojects all data from the local coordinate system to world coordinate system and overlay

them on Google Maps base map infrastructure.
SMS uses a web server and a data server. Web server provides access to World Wide Web and data storage server provides all functionality and security to data management and handling.
Extending spatially the areas (regions) of SMS application is possible by adding a new Location to the central database. Any new Location must have a well defined coordinate system and specific extends. Only the system administrator of the system have the authority to extend spatially the SMS database.

Coordinate System for Region Peloponnesus.

The Hellenic Geodetic Reference System 1987 or HGRS87 (Greek: Ελληνικό Γεωδετικό Σύστημα Αναφοράς 1987 or ΕΓΣΑ'87) is a geodetic system commonly used in Greece. The system specifies a local geodetic datum and a projection system. In some documents it is called Greek Geodetic Reference System 1987 or GGRS87.

HGRS87 datum
HGRS87 specifies a non-geocentric datum that is tied to the coordinates of the key geodetic station at the Dionysos Satellite Observatory (DSO) northeast of Athens (38.078400°N 23.932939°E). The central pedestal (CP) at this location has by definition HGRS87 coordinates 380 4' 33.8000" N - 230 55' 51.0000"E, N = +7 m.
Although HGRS87 uses the GRS80 ellipsoid, the origin is shifted relative to the GRS80 geocenter, so that the ellipsoidal surface is best for Greece. The specified offsets relative to WGS84 (WGS84-HGRS87) are: Δx = -199.87 m, Δy = 74.79 m, Δz = 246.62 m.
The HGRS87 datum is implemented by a first order geodetic network, which consists of approximately 30 triangulation stations throughout Greece and is maintained by the Hellenic Military Geographical Service. The initial uncertainty was estimated as 0.1 ppm (1x10−7). However there are considerable tectonic movements that move parts of Greece towards different directions, causing incompatibilities between surveys taking place at different times.

Coordinate System for Region Sicily.

Please add coordinate system definition.

Launching SMS Application

To get started using the SMS web application right away, just type the following address into your web browser or click on the link below.

http://www.soilpro.eu/en/webgis

Alternative go to SoilPro.eu and from the main menu choose WEBGIS.

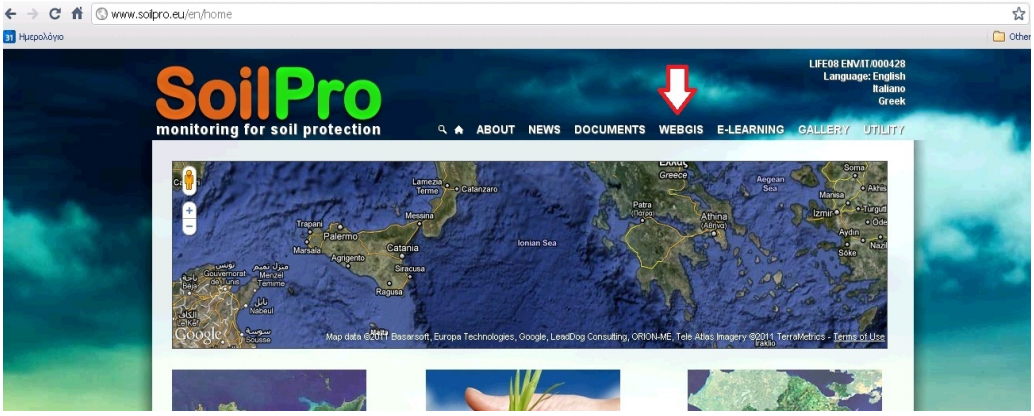

Illustration 1: Soilpro web site.

The first time you access the application a large amount of information is transferred to your computer, and it may take up to 60 seconds for it to load depending on your computer speed, internet connection type, and server load. The average load time is about ten seconds. SMS application is linked to the web portal of SoilPro project.

SMS Layout.

SMS application is aiming to all soil users and stakeholders. For this reason it is designed to facilitate the communication between stakeholders with limited knowledge to IT techniques and with minimum support. When initiated the welcome screen appears.

Home
Peloponnesus
Sicily
Login
Register
Admin
Welcome to SOILPRO SMS
SMS (Soil Monitoring Software) is a web based application developed by the University of Athens in collaboration with CRA ABP. The application supports all critical functions required for soil monitoring and management, based on the soil monitoring methodology developed by CRA ABP. The use of Information Technology and the web environment renders the aforementioned methodology fully operational at the level of Local and Regional Authorities (LRAs).
Project Description
The project LIFE08 ENV/IT/00428 SOILPRO began on 1st January 2010 and will last four years, until 31st December 2013. SOILPRO is a project financed among the LIFE+ (Environment Policy and Governance) projects. The overall objective of the project is to halt soil degradation in EU Member States in line with the European Thematic Strategy for Soil Protection
Life

Illustration 2: SMS Welcome screen

The Welcome screen in SMS application briefly informs visitors for the scope of SMS application and SoilPro Project. The Life+ logo is in accordance to the Life+ funding provisions.

User may choose to which location to navigate. As until today there are two locations in the SMS database. Region of Peloponnesus (Greece) and Region Sicily (Italy). Not registered users may navigate in the application and browse available data and models. For further information on user management please refer to **User Management Options**.

There are 6 distinct tabs in the SMS application. ***Home*** tab hosts the welcome screen of the application. ***Peloponnesus*** and ***Sicily*** tabs (Location tabs) enclose the information and models for the two project Locations. ***Login*** tab and ***Register*** tab facilitate user register and access the application. ***Admin*** tab provides access to functions available only to SMS administrator.

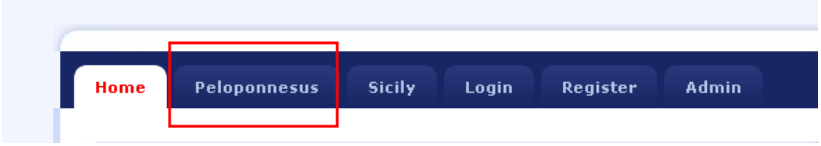

Illustration 3: SMS tabs

All Location tabs have an identical structure. When a Location tab is selected user has

access to ***Home*** tab ***Location*** tab and ***Model*** Tab.

Illustration 4: Peloponnesus Location

Location tab encloses four section, **Layers**, **Data List**, **Data Pending** and **Data Upload**.

- In **Layers** user can browse all available layers in the selected location.
- In **Data List** user can download data, relevant maps or can delete selected layers.
- In **Data Pending** section User can import data to the SMS application from the data storage server. In **Data Upload** section user can upload data to the SMS data server. Alternative user can have a direct access to the SMS data server by mounting the server in his workstation.

Under Models tab, there are two sections, **Model List** section and **Model Upload Form** section.

- In **Model List** section user may browse available models, execute a model, or delete it.
- In **Model Upload Form** section user can write a new model and submit it. For further details please refer to *GIS Modeling in SMS*.

Features of SMS Application.

SMS web application of a geographic information system based on GRASS GIS platform is basically a shell application allowing the user to query and manipulate a part of the database over the Internet and expand the capabilities of the application. In this way, SMS, makes geographic information available to the citizens and users of each network at any time and from any location. All citizens, stakeholders and LRa's concerned will have easy access to the application and will be able to manage geographic data (display of different layers etc.) and display and query the database. In general there are following groups of functionality in the SMS application.

User Management

User in order to have access to SMS functionality it is required to register providing limited information and contact details. Registered users will be given a user name and a password for secure access to SMS application and also data storage in the SMS Server. User management responsibility is preformed by the System

administrator.

SMS User Registration.

User registration requires the following fields to be completed by the user.
First and Last Name. User's email address, the Organization user represents, the Mapset he wishes to work with and the UserType (Please Refer to User Management Options Below, or press Help for more information on user previliges).
Any user can download the latest version of the SMS user manual from the link below.

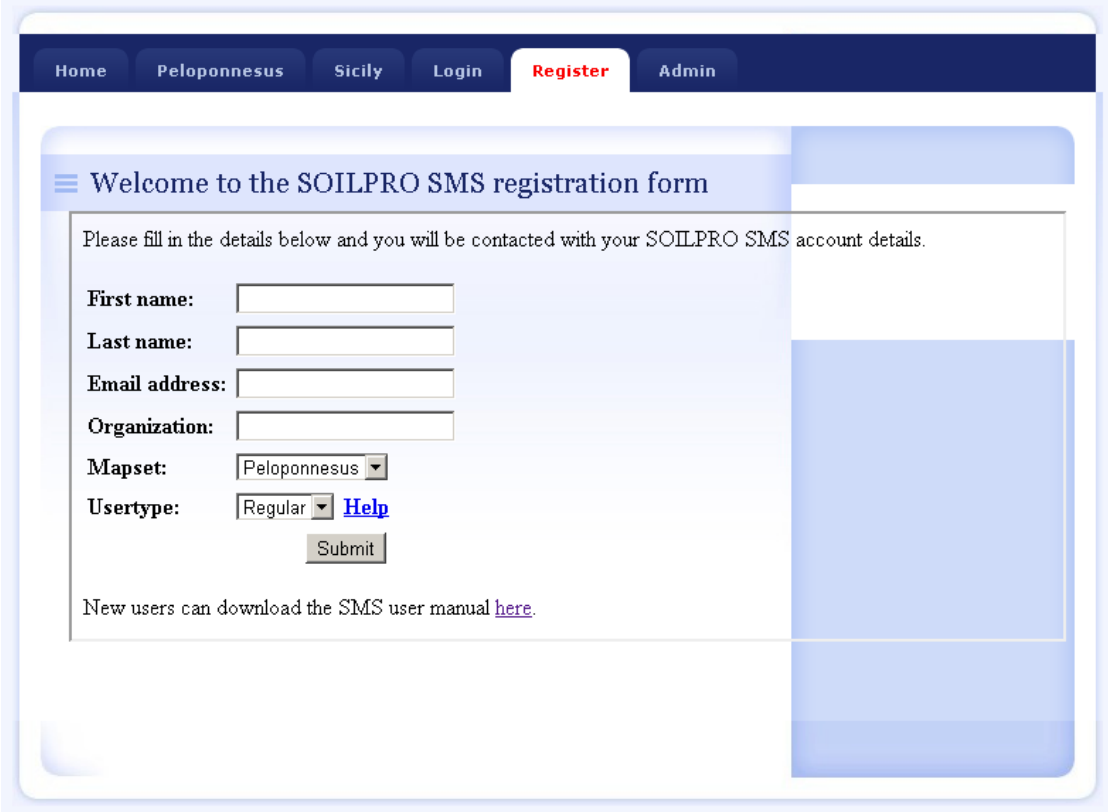

Illustration 5: Illustration 5: Register Tab

By submitting his details user will receive by the system administrator a user name and a password by email.

User Management Options.

There are four different type of users in SMS application.

General Public

- Can view data (all locations)
- Can view models (all locations)
- It is not necessary to register.

Regular User

- Can view data (all locations)
- Can view models (all locations)
- Can download data (single location)

Power User

- Can view data (all locations)
- Can view models (all locations)
- Can download data (single location)
- Can upload data (single location)
- Can delete data (single location)
- Can create models (single location)
- Can delete models (single location)
- Can run models (single location)

Admin

- Has full access to all locations.
- Has access to Admin tab section

Login in SMS Application.

From the **Login** Tab users may login to SMS. Before logging in the application user must receive an email by the SMS administrator providing a valid User name and a password. By signing in the SMS application, user automatically initiates a thread on the SMS server. All data handling and actions are monitored and handled by this thread.

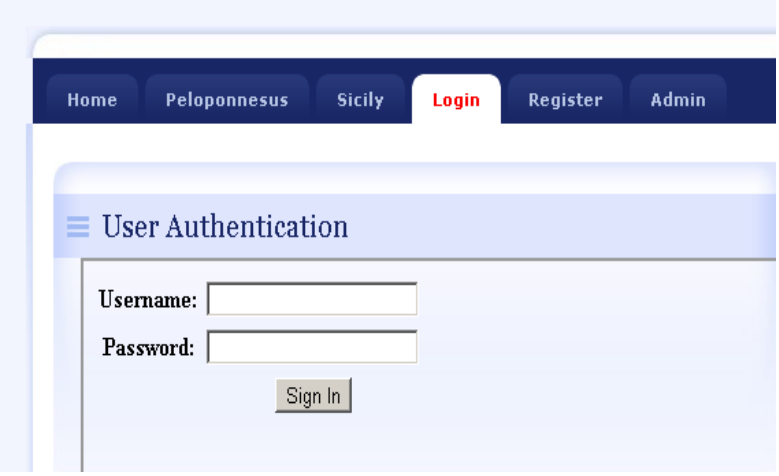

Illustration 6: SMS login page.

User may sign in the application. By closing the browser automatically he closes the work section and cancels the thread on the SMS server. In order to continue, user needs to log on to the system again, initiating a new thread on the system.

Data Management

In the SMS application user can load data in the application with two different methods. By mounting the data repository on his workstation or by using the data load function through the application.
Two type of data have been tested as of today. Raster data (grids) and vector data (shapefiles). Raster data can be imported as ASCII grids or .img image files. ASCII format is a neutral format that can be easily transferred. Shapefiles can be imported directly to the SMS application.

Data Load - Method - Storage Mount.

In SMS application user can import data in the application server by a simple copy paste procedure.

Initially user needs to mount the storage space of the data server.

- Open a windows file explorer.
- Type in the address tab: \\soilprosms.dyndns.org

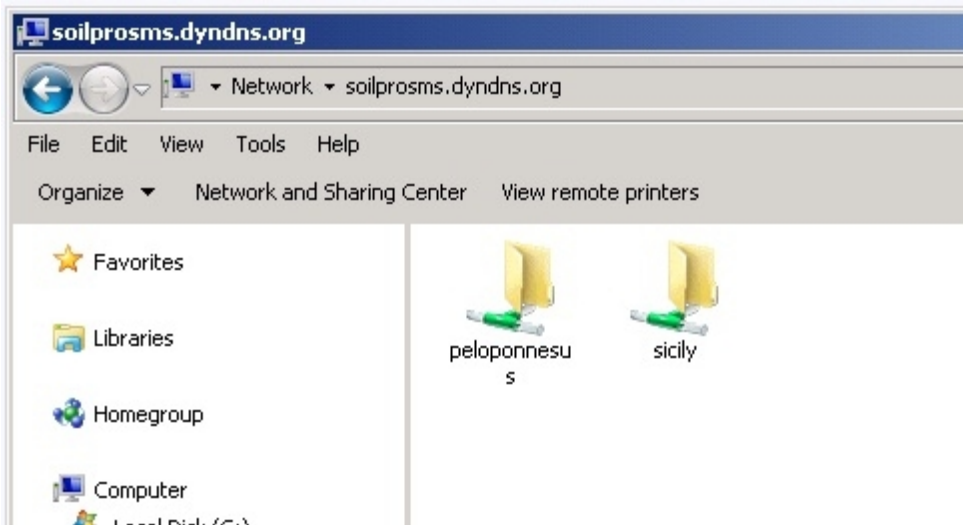

Illustration 7: Data Storage Server - Available Locations

The above path provides access to the data server storage. A user name and password will be provided to the user by the database administrator.
User needs to select the location to upload data (Peloponnesus or Sicily). Alternative User can mount to his workstation one of the two locations.

- Right click on the selected location (Peloponnesus or Sicily)
- Select: Map Network Drive...
- Drive will appear as a local drive in user's workstation.

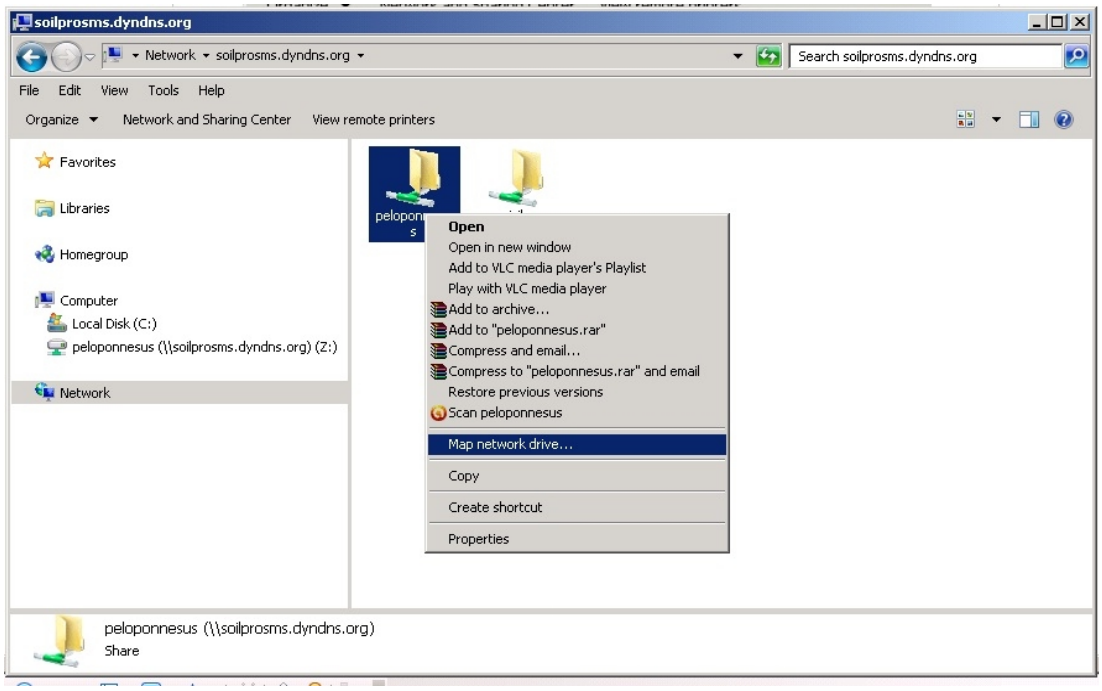

Illustration 8: Mount Location

Data Transfer to data server.

Drag and drop files to the mapped network drive from any location.

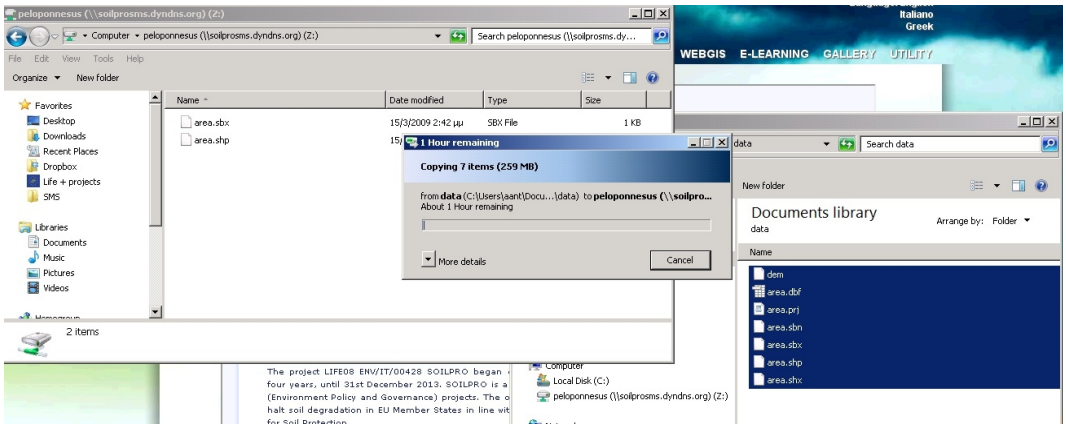

Illustration 9: Drag & Drop

This procedure will take from several minutes up to 1 hour depending the available bandwidth and data volume. All selected data will be transferred to the SMS data server in the selected location. Data from one location will not be available to other locations. For security reasons user is authorized to mount only one location in the data server.

Data Upload.

SMS user can upload data through the application. In the Location Tab at the last section user can upload data by using the Data Upload tool. The tool works in two steps.

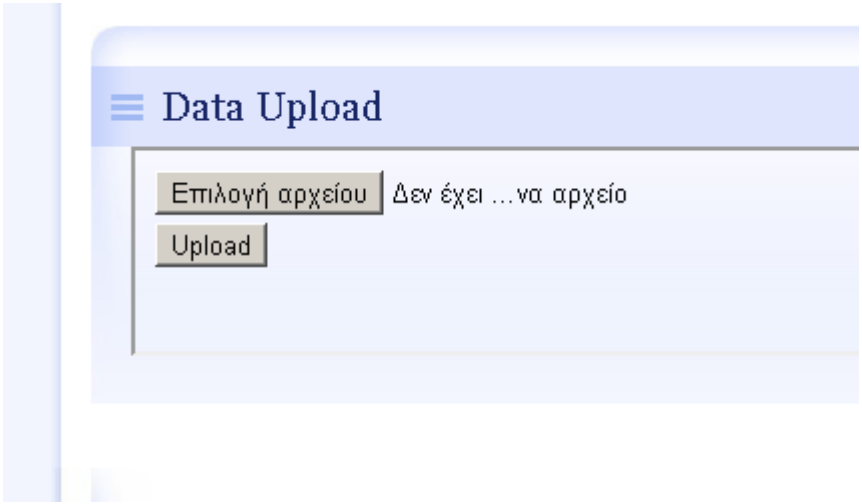

Illustration 10: Data Upload Section

In the first step user chooses a file to upload by clicking on the Choose File button. A data browser will appear and user can navigate to the selected location.

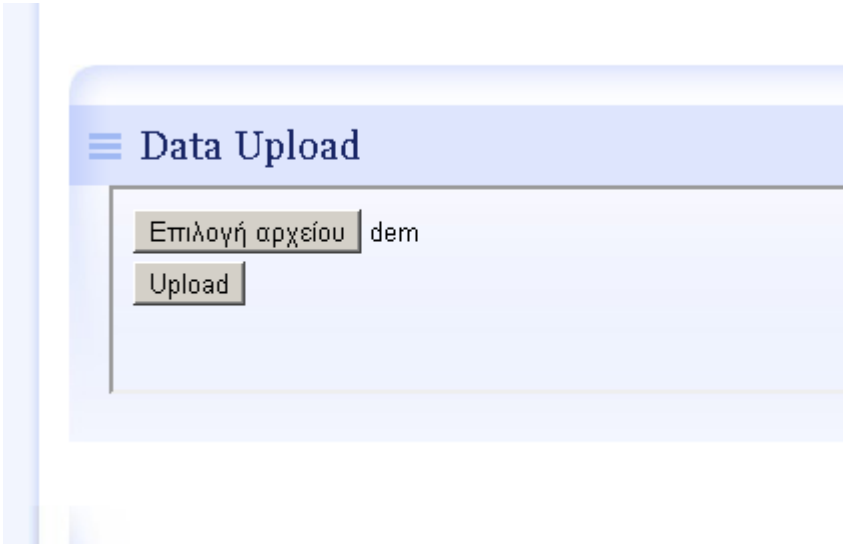

Illustration 11: File selection

Finally user must click on the Upload button and the data will be uploaded to the data server of SMS application.

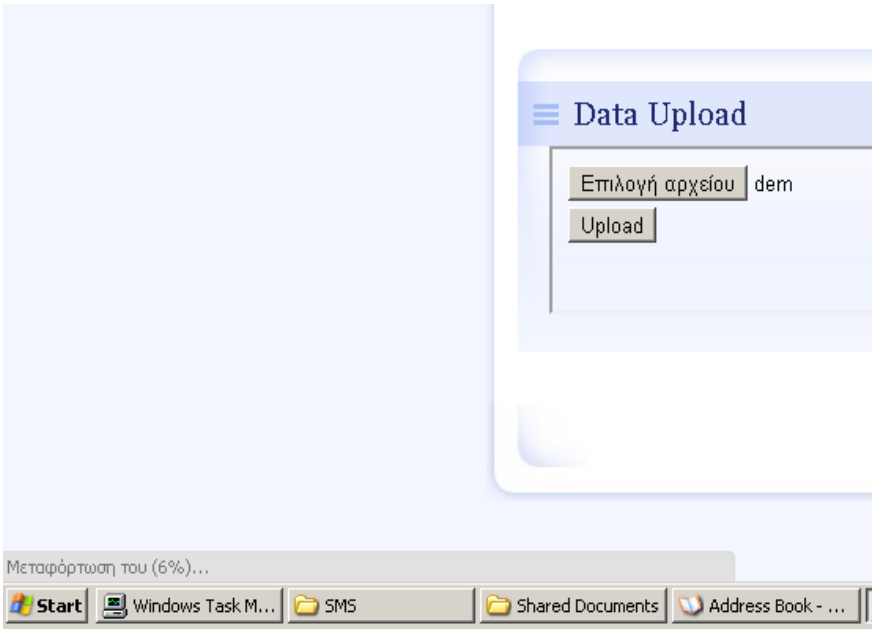

Illustration 12: Uploading procedure

In some browsers user can monitor the upload process of the upload.

Data Import.

As soon as data are transferred to data server, SMS application reacts and provides information to SMS users on data availability.
User has to follow the next steps in order to finalize data import to SMS application.

- Login in the SMS application using provided user name and password.
- Select the desired location tab.
- Move to Data Pending section.
- For importing a raster file, just select import.
- For shapefile import, choose the correct topology first, then select import.

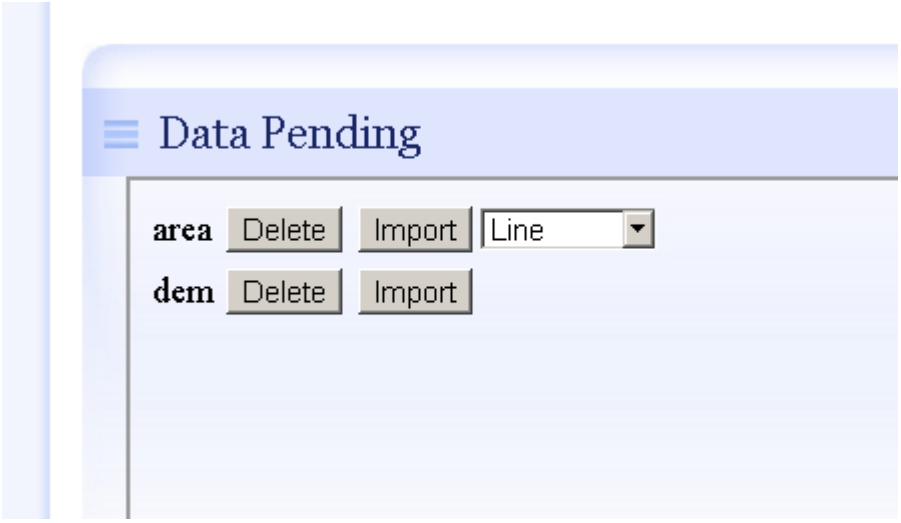

Illustration 13: Data Import

SMS application understands automatically the data type that is located in the dataserver. In the example above dem is an raster ascii file and area is a shapefile. User needs to select import in both layers in order to finalize import procedure. In the case of raster files by selecting import, the final raster layer will be created in SMS. In the case of shapefiles, user must identify the correct topology of the dataset. There are three cases. A point shapefile, a line shapefile and finally a polygon shape file. In the first case user must select point, in the second case line and in the third case boundary.
The result will be visible in the first section of Location tab, **Layers**, where thumbnails will be available for all imported layers. In the **Data List** section user may download raw data and/or data in tiff, img data. User can delete the layer. (more information in the appropriate sections).

Although ASCII grid files have a straight forward import procedure, for shapefiles import needs more attention by the User. A "shapefile" is actually a set of several files. Three individual files are mandatory to store the core data that comprises a shapefile: ".shp", ".shx", ".dbf", and other extensions on a common prefix name (e.g., "area.*"). The actual shapefile relates specifically to files with the ".shp" extension, but alone is incomplete for distribution, as the other supporting files are required.
There are a further eight optional files which store primarily index data to improve performance. Each individual file should conform to the MS DOS 8.3 filename convention (8 character filename prefix, period, 3 character filename suffix such as shapefil.shp) in order to be compatible with past applications that handle shapefiles, though many recent software applications accept files with longer names. For this same reason, all files should be located in the same folder.

Mandatory files :

- .shp — shape format; the feature geometry itself
- .shx — shape index format; a positional index of the feature geometry to allow seeking forwards and backwards quickly
- .dbf — attribute format; columnar attributes for each shape, in dBase IV format

Optional files :

- .prj — projection format; the coordinate system and projection information, a plain text file describing the projection using well-known text format
- .sbn and .sbx — a spatial index of the features
- .fbn and .fbx — a spatial index of the features for shapefiles that are read-only
- .ain and .aih — an attribute index of the active fields in a table or a theme's attribute table
- .ixs — a geocoding index for read-write shapefiles
- .mxs — a geocoding index for read-write shapefiles (ODB format)
- .atx — an attribute index for the .dbf file in the form of shapefile.columnname.atx (ArcGIS 8 and later)
- .shp.xml — geospatial metadata in XML format, such as ISO 19115 or other schemas
- .cpg — used to specify the code page (only for .dbf) for identifying the character encoding to be used

In each of the .shp, .shx, and .dbf files, the shapes in each file correspond to each other in sequence. That is, the first record in the .shp file corresponds to the first record in the .shx and .dbffiles, and so on. The .shp and .shx files have various fields with different endianness, so as an implementor of the file formats you must be very careful to respect the endianness of each field and treat it properly.

IMG Data Import

IMG file format is a multiband format allowing storing many layers in one file. By importing any multiband file in SMS each band will be imported as a single raster file. Then user can produce any combination by using the group command.

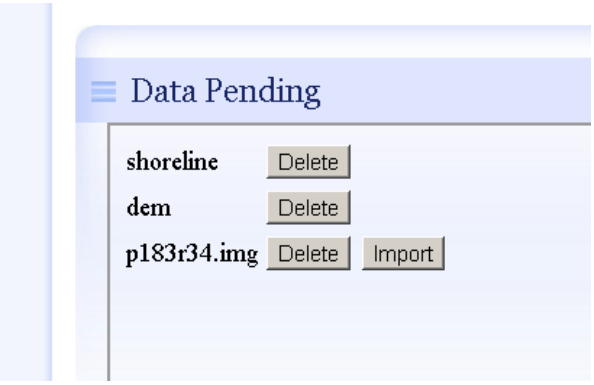

Illustration 14: img image import

Unlike single raster layers, one img file may populate one to n layers. In the example below there are 8 layers produced (landsat image).

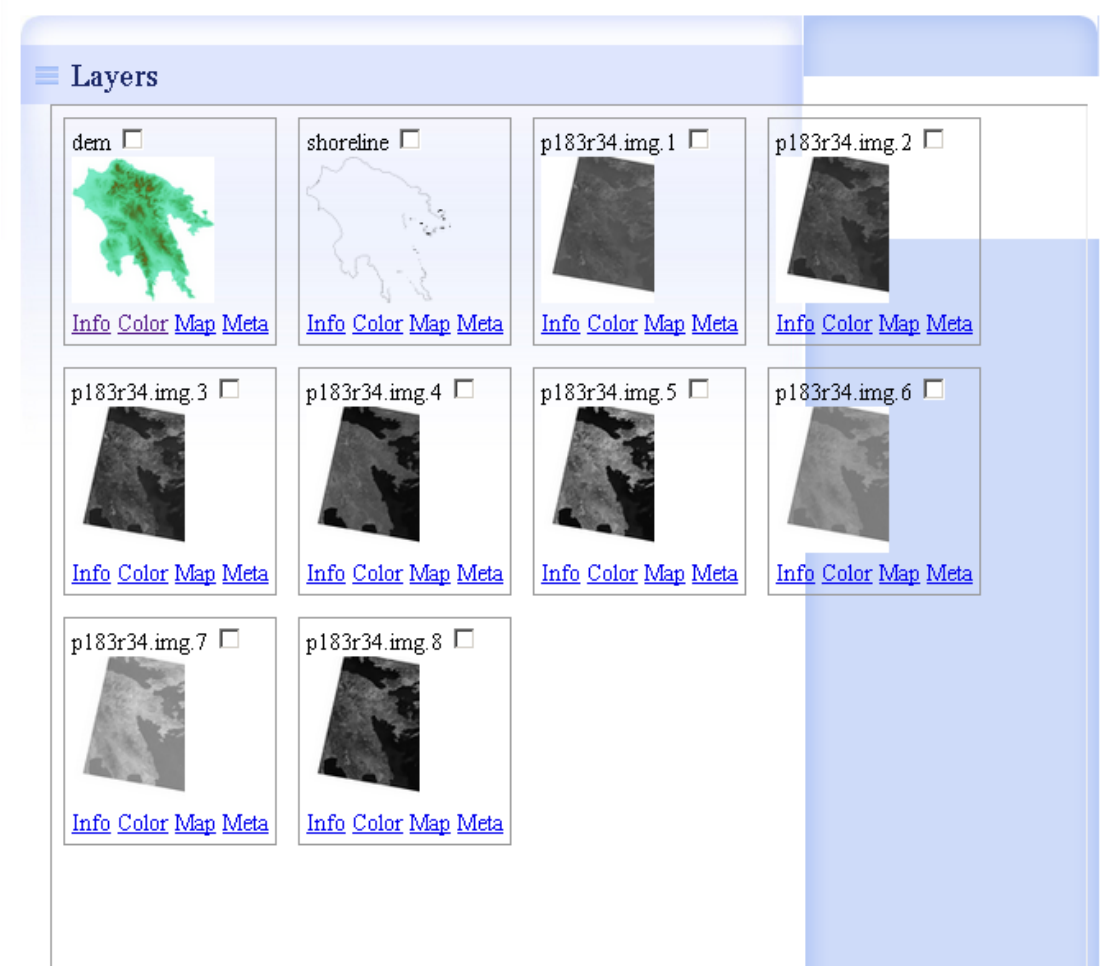

Illustration 15: Landsat bands

Data Browsing.

The first section in the location tab is **Layers**. In **Layers** tab all available layers are accessible through a thumbnail image.
For basic management functions are available through Layers tab:

- Info.
  - Basic statistical information on layer characteristics.
- Color.
  - Layer color scheme management
- Map.
  - Layer mapping and layer superimpose on google maps
  - Layer on layer mapping
- Meta (metadata).
  - Metadata for raster or vector data.

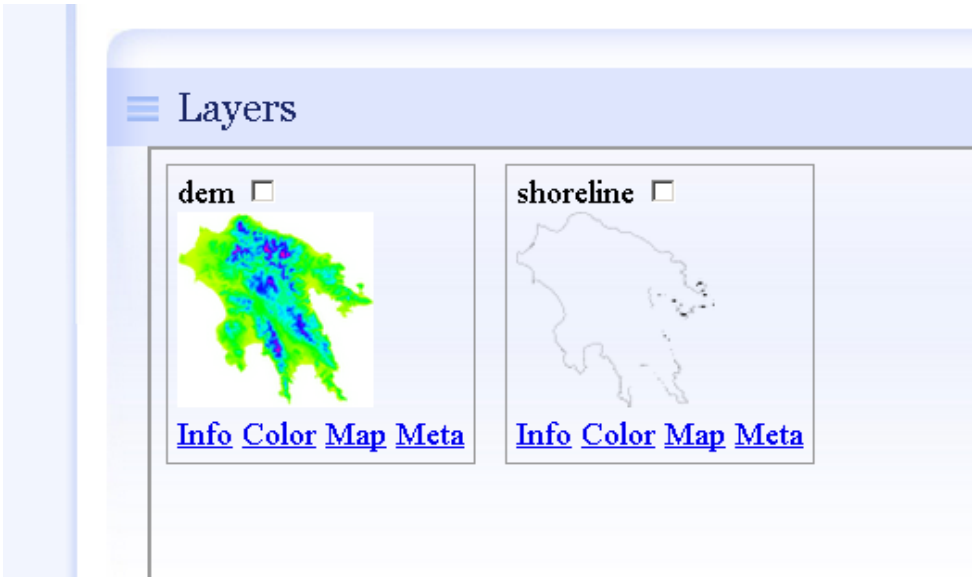

Illustration 16: SMS layer browsing.

Map: Mapping on SMS

- For viewing the layer user needs to select it by ticking the tick box above the layer's thumbnail.
- Then select map and the selected layer(s) will be superimposed over google-maps base maps.
- By selecting multiple layers user superimposes them on google maps.

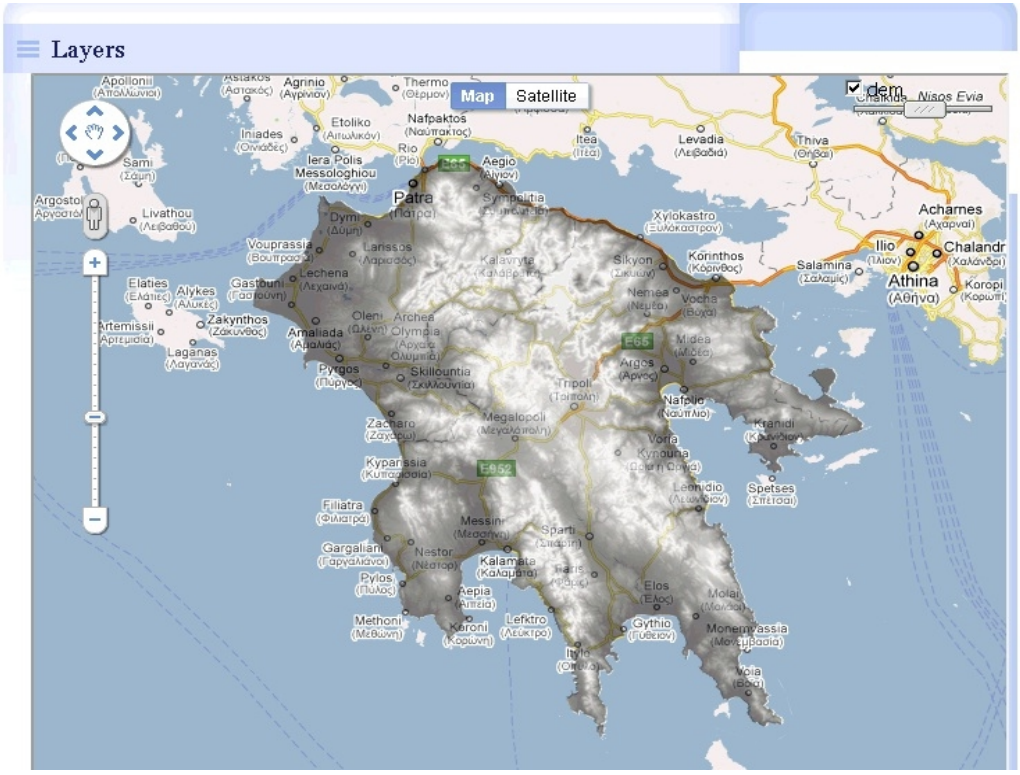

Illustration 17: Layer superimposed on Google Maps

Google Maps provide a standard base map infrastructure with up to date information. User may change the base map from Map to Satellite. There is a Pan Button and a Zoom in - Zoom out Bar. At the top right, the user may switch on – off the selected layers or reduce layer transparency. Automatically a pop up window will appear on the user's screen. If a Legend is available for the selected layer, the legend will appear on the pop up window, otherwise the window will be empty.

Color: Modification of Layer's color scheme.

User can modify the default layer's color scheme automatically or manually. Automatically user can select from a series of predefined color pallets a more suitable palette for the selected layer. By selecting Color below the layer's thumbnail the Color Style Selection Tools initiates.

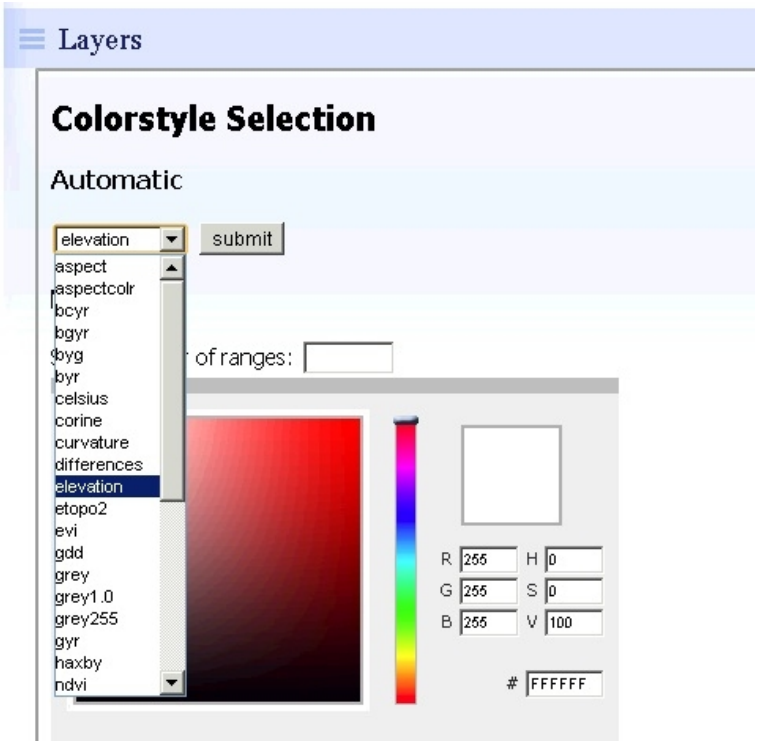

Illustration 18: Color Selection Tool

For the Digital Elevation Model there are several predefined color palettes. For example elevation provides vivid colors for DEMs. Then click submit. SMS will recreate all image files and maps associated with the specific layer. The process will take few seconds. A new thumbnail will appear in the Layer section. All images and maps associated with any layer is automatically generated in SMS. These images can be altered and modified according to user needs if color is selected below the thumbnail.

- For viewing the layer user needs to select it by ticking the tick box above the layer's thumbnail.
- Then select map and the selected layer(s) will be superimposed over google-maps base maps.

Below user can find a brief description of the basic standard color pallets that are available in SMS application.

- **aspect**: aspect oriented grey colors
- **aspectcolr**: aspect oriented rainbow colors
- **bcyr**: blue through cyan through yellow to red
- **bgyr**: blue through green through yellow to red
- **byg**: blue through yellow to green

- **byr**: blue through yellow to red
- **celsius**: blue to red for degree Celsius temperature
- **corine**: EU Corine land cover colors
- **curvature**: for terrain curvatures (from v.surf.rst and r.slope.aspect)
- **differences**: differences oriented colors
- **elevation**: maps relative ranges of raster values to elevation color ramp
- **etopo2**: colors for ETOPO2 worldwide bathymetry/topography
- **evi**: enhanced vegetative index colors
- **gdd**: accumulated growing degree days
- **grey**: grey scale
- **grey.eq**: histogram-equalized grey scale
- **grey.log**: histogram logarithmic transformed grey scale
- **grey1.0**: grey scale for raster values between 0.0-1.0
- **grey255**: grey scale for raster values between 0-255
- **gyr**: green through yellow to red
- **haxby**: relative colors for bathymetry or topography
- **ndvi**: Normalized Difference Vegetation Index colors
- **population**: color table covering human population classification breaks
- **population_dens**: color table covering human population density classification breaks
- **precipitation**: precipitation color table (0..2000mm)
- **precipitation_monthly**: precipitation color table (0..1000mm)
- **rainbow**: rainbow color table
- **ramp**: color ramp
- **random**: random color table
- **rstcurv**: terrain curvature (from r.resamp.rst)
- **rules**: create new color table based on user-specified rules read from stdin
- **ryb**: red through yellow to blue
- **ryg**: red through yellow to green
- **sepia**: yellowish-brown through to white
- **slope**: r.slope.aspect-type slope colors for raster values 0-90
- **srtm**: color palette for Shuttle Radar Topography Mission elevation
- **terrain**: global elevation color table covering -11000 to +8850m
- **wave**: color wave

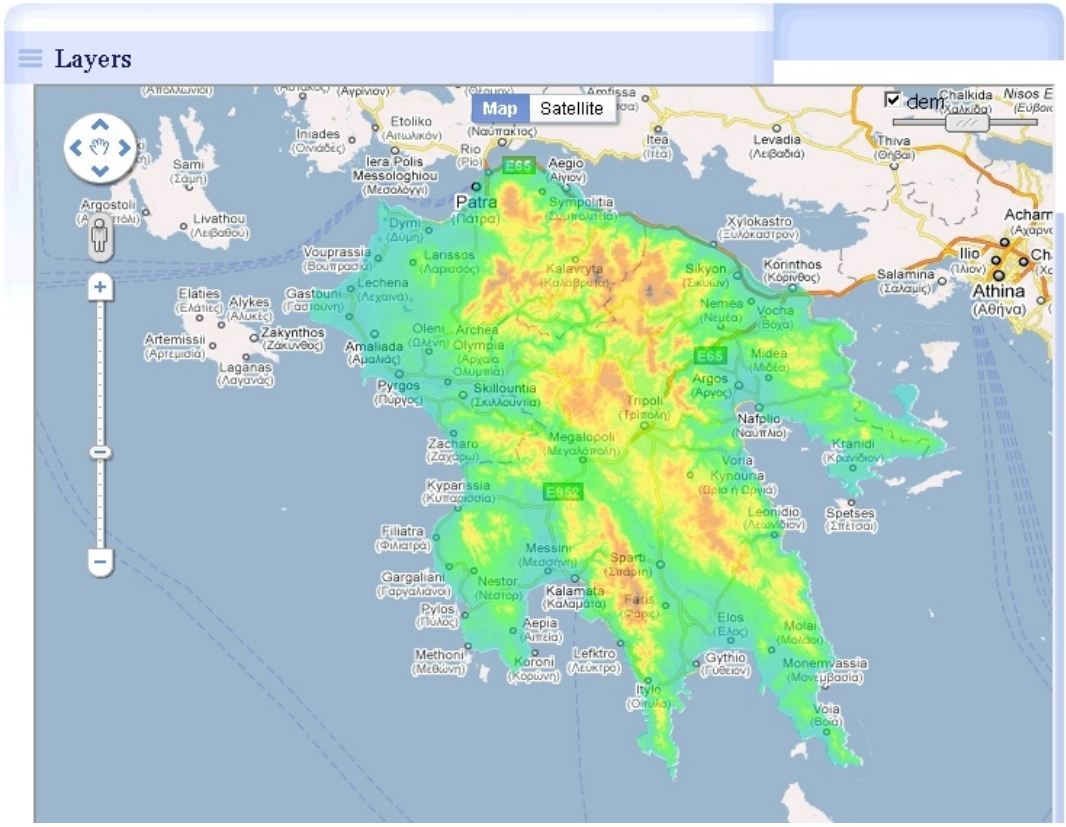

Illustration 19: Updated colormap

For manual color selection user has to identify the number of classes and the corresponding legend text. By selecting Color below the layer's thumbnail the Color Style Selection Tools initiates. The following steps have to be taken.

- Provide the number of ranges.
- Select color using the interactive color selection tool for each class.
- Provide a text description for each class.
- Submit request.

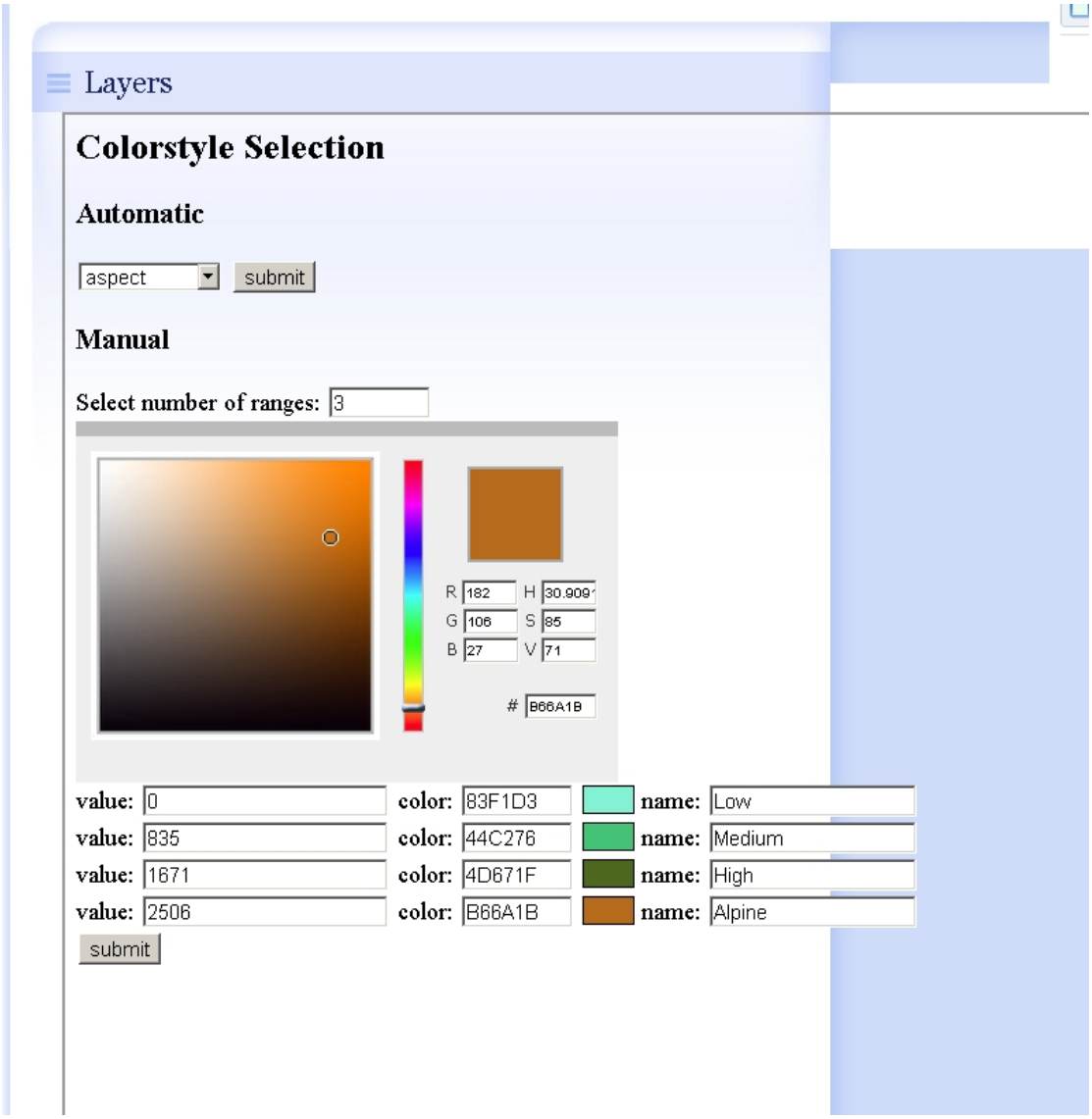

Illustration 20: Colormap Selection Tool - Manual Color Selection

SMS will recreate all image files and maps associated with the specific layer. The process will take few seconds. A new thumbnail will appear in the Layer section. All images and maps associated with any layer are automatically generated in SMS. These images can be altered and modified according to user needs if color is selected below the thumbnail.

- For viewing the layer user needs to select it by ticking the tick box above the layer's thumbnail.
- Then select map and the selected layer(s) will be superimposed over google-maps base maps.
- At the bottom of the map area layer legend will appear.

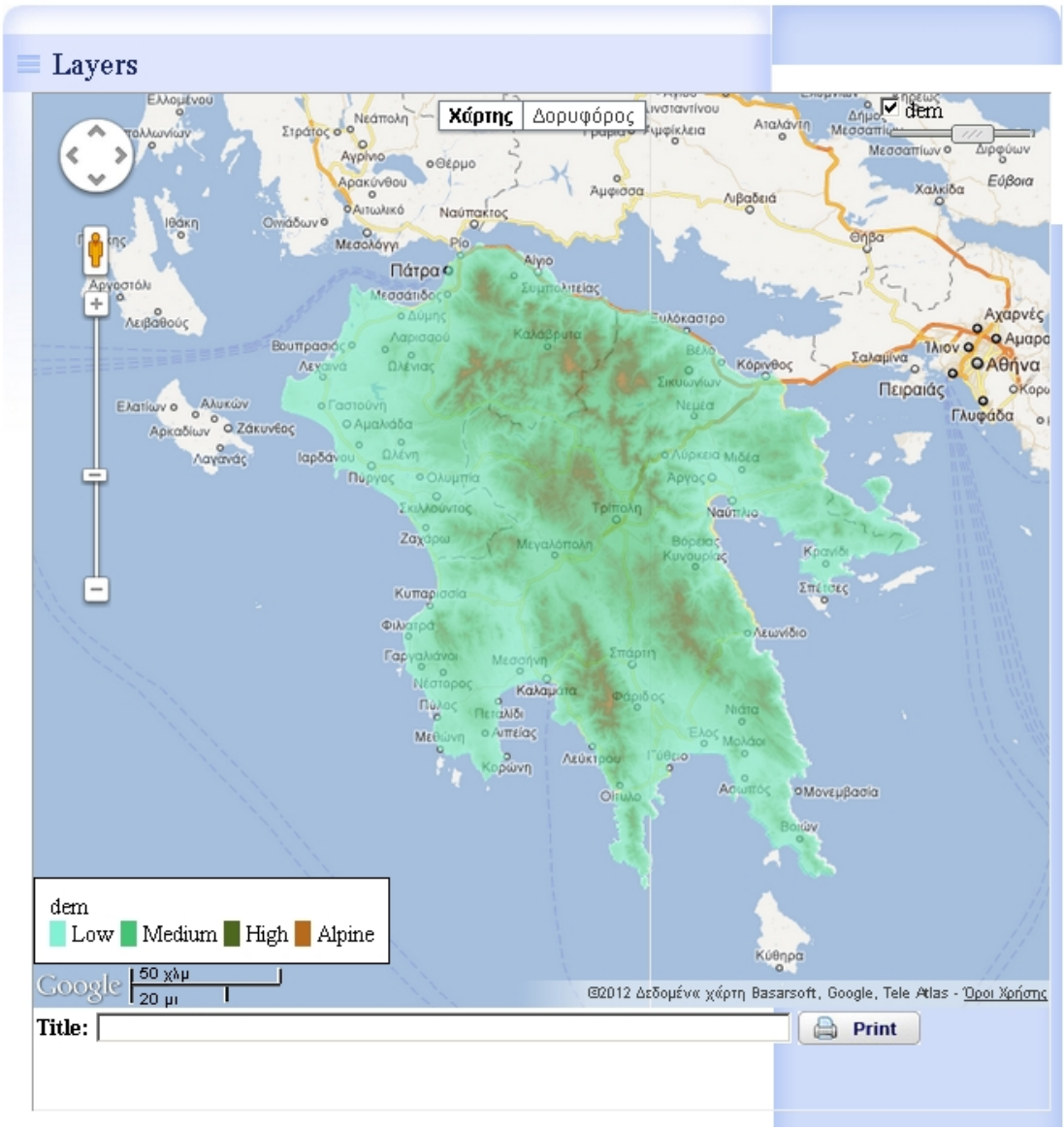

Illustration 21: Layer with Legend

Printing Map.

SMS users can produce soft copy maps directly from the application. Below the map area Users can input the Map Title.

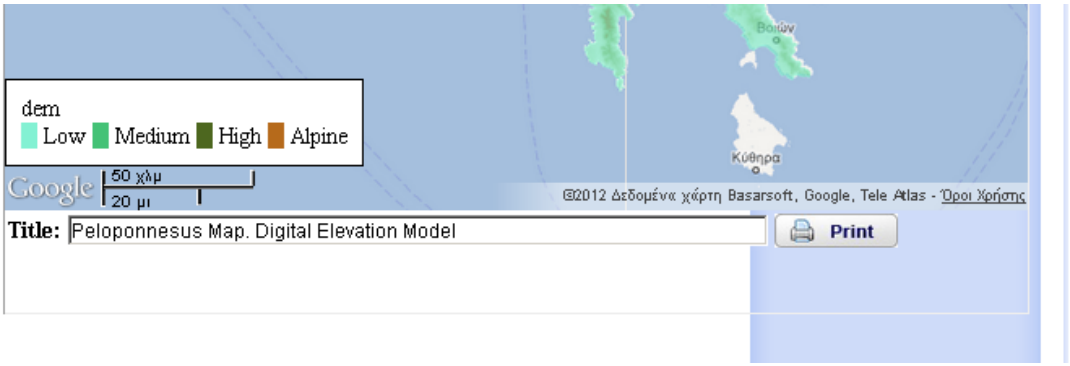

Illustration 22: SMS Print Function.

By selecting PRINT user initiates the print function of his browser. Depending of the available browser, the remaining steps may differ. The following example is from IE.

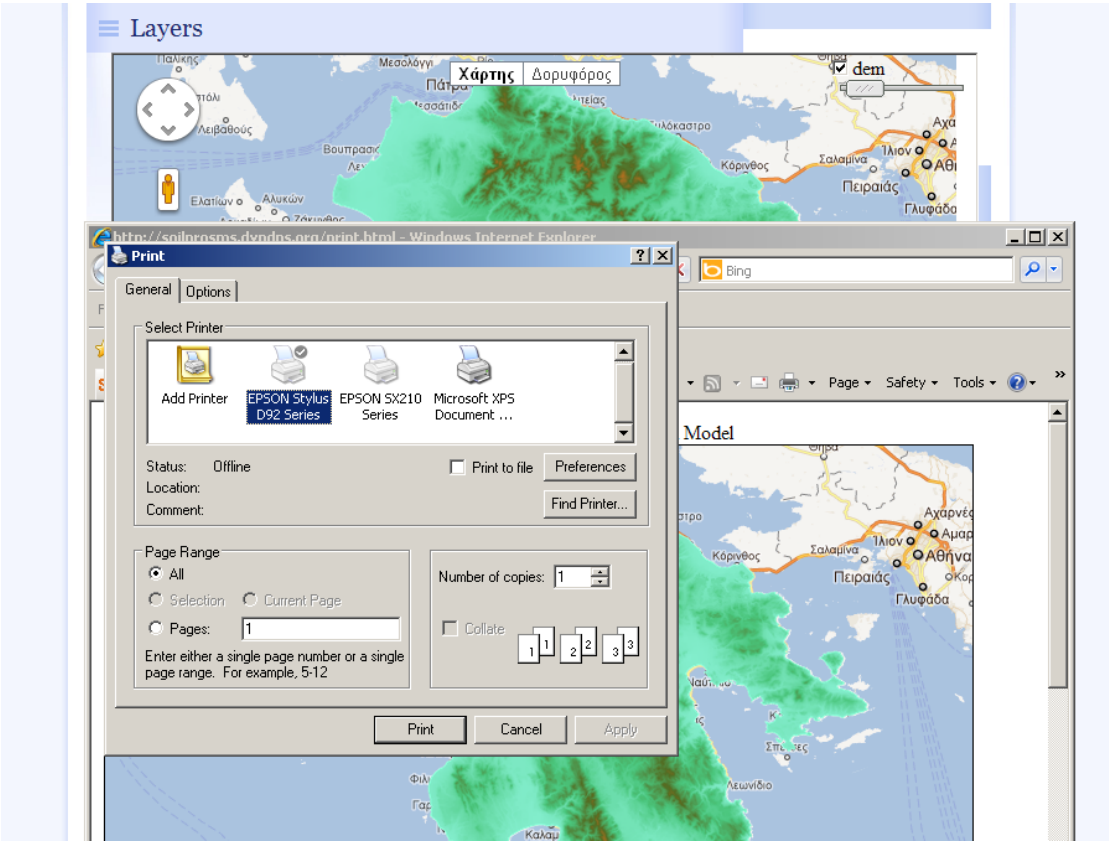

Illustration 23: Printing in Internet Explorer

INFO: Basic statistical information.

Info functions provides all the basic layer information. By selecting Info the user will see on screen the following information table.

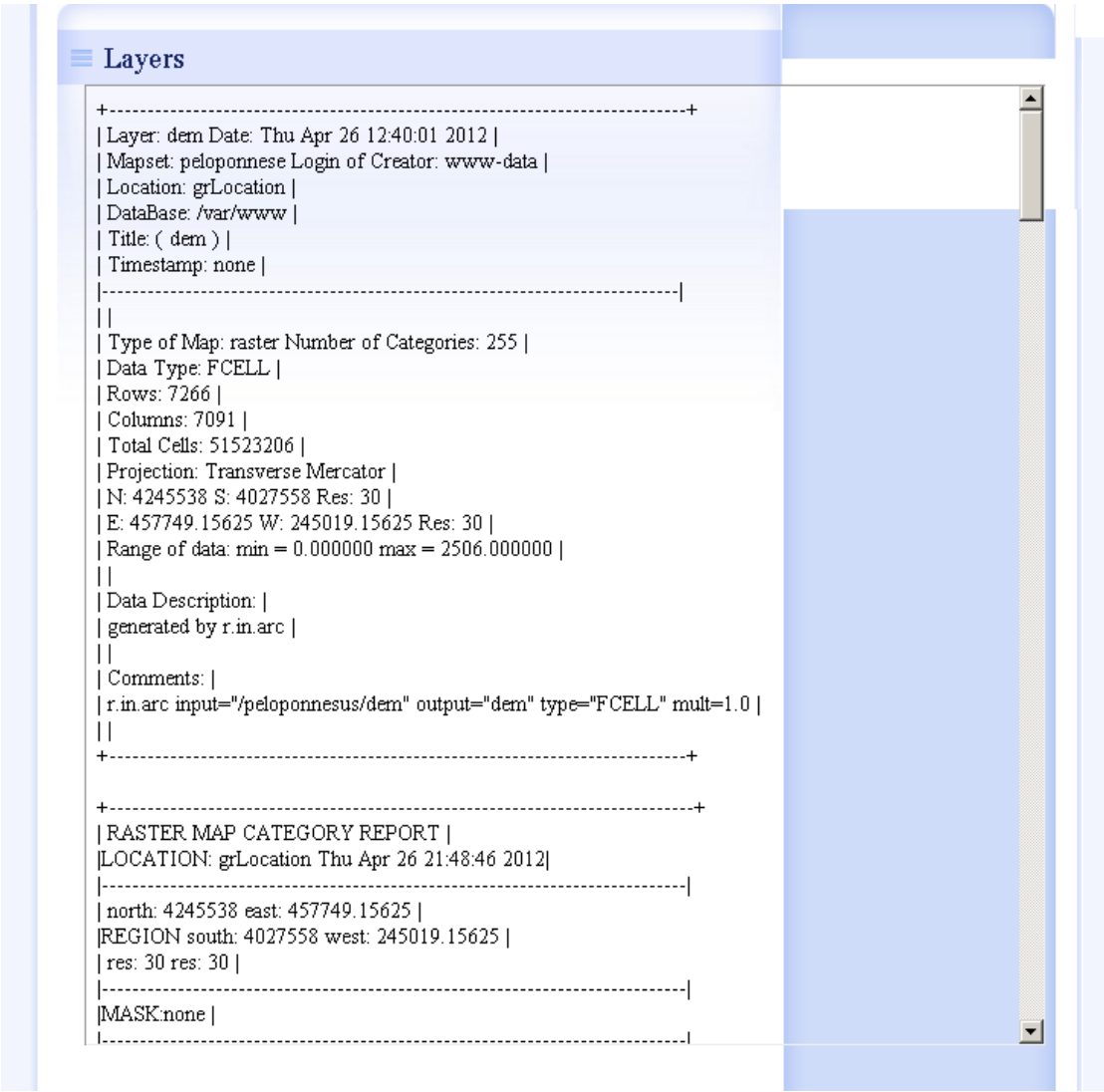
Layers
+----------+
| Layer: dem Date: Thu Apr 26 12:40:01 2012 |
| Mapset: peloponnese Login of Creator: www-data |
| Location: grLocation |
| DataBase: /var/www |
| Title: (dem) |
Timestamp: none
Type of Map: raster Number of Categories: 255
Data Type: FCELL
Rows: 7266
Columns: 7091
Total Cells: 51523206
Projection: Transverse Mercator
N: 4245538 S: 4027558 Res: 30
E: 457749.15625 W: 245019.15625 Res: 30
Range of data: min = 0.000000 max = 2506.000000
Data Description:
generated by r.in.arc
Comments:
r.in.arc input="/peloponnesus/dem" output="dem" type="FCELL" mult=1.0
+----------+
+----------+
| RASTER MAP CATEGORY REPORT |
LOCATION: grLocation Thu Apr 26 21:48:46 2012
north: 4245538 east: 457749.15625
REGION south: 4027558 west: 245019.15625
res: 30 res: 30
MASK:none

Illustration 24: Basic layer information

The table is divided in several parts. The first part includes information on the Location of the grass gis database and the creation date. in the second part there are information on the projection used and the generation method. For example Dem is imported by using the command:

r.in.arc input="/peloponnesus/dem" output="dem" type="FCELL" mult=1.0

Meta: User Defined metadata.

User in SMS has the ability to store user defined set of metadata information. There are two sets of metadata available in SMS, metadata for Raster and metadata for vector layers. In both cases the metadata fields are defined explicitly by the overall administrator in the ***Admin*** tab. Although the metadata function in SMS is simple in principal, it is strongly advised to avoid changes in the structure of the metadata

table, since any change may end up with data lose. In the ***Admin*** tab administrator adds or deletes fields of metadata for vector or raster layers.

Illustration 25: Raster metadata table

From the Location tab, by selecting Meta, user can access the metadata database and complete the available fields. The procedure for raster and vector data is identical.

Data Handling.

Data in SMS can be handled according to user rights. There are two types of data that can be handled in SMS. Raw grid data (initial or produced) in raster format and map image data (georeferenced images). In the first case user can download for the selected layer a compressed file containing the ascii grid file, and/or the same layer in img file format. In the second case user will download a compressed file containing a georeferenced file of the selected layer and the associated legend file in html format. The georeferenced file is in GeoTIFF format. GeoTIFF is a public domain metadata standard which allows georeferencing information to be embedded within a TIFF file. The potential additional information includes map projection, coordinate systems, ellipsoids, datums, and everything else necessary to establish the exact spatial reference for the file. The GeoTIFF format is fully compliant with TIFF 6.0, so software incapable of reading and interpreting the specialized metadata will still be able to open a GeoTIFF format file. User can use GeoTIFF in any GIS or CAD system and associate it with his datasets, or can be used as single image for reporting in any text editor or other relevant software. The resolution of the GeoTIFF is in accordance with the spatial resolution of the selected layer. Legend is in html format and allows the user to increase or reduce size without any detail loses. In order to succeed maximum compatibility in the zip file user will also find a .tfw file (World file).

Data downloading.

Under the Location tab in the Data List section user can select to download data (Ascii file) or to download tif (geo-referenced tif with legend) and download dataset in img format.

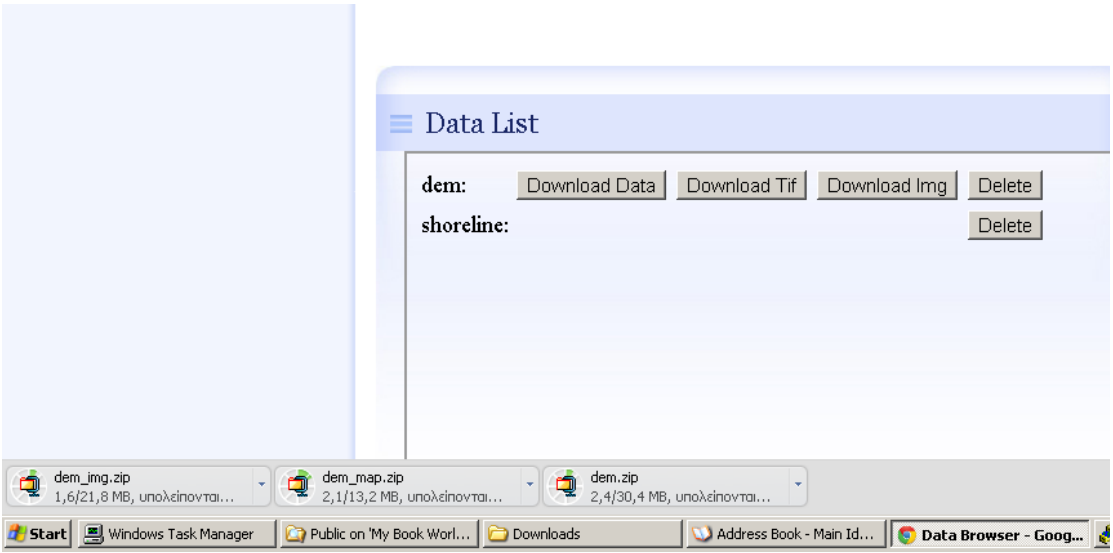

Illustration 26: Download options and procedure

Data downloading – Data.

- Open a windows explorer and navigate to the download folder.
- Open dem.zip.
- Open the ascii file using world pad. (it will take few minutes)
- Examine the file header.

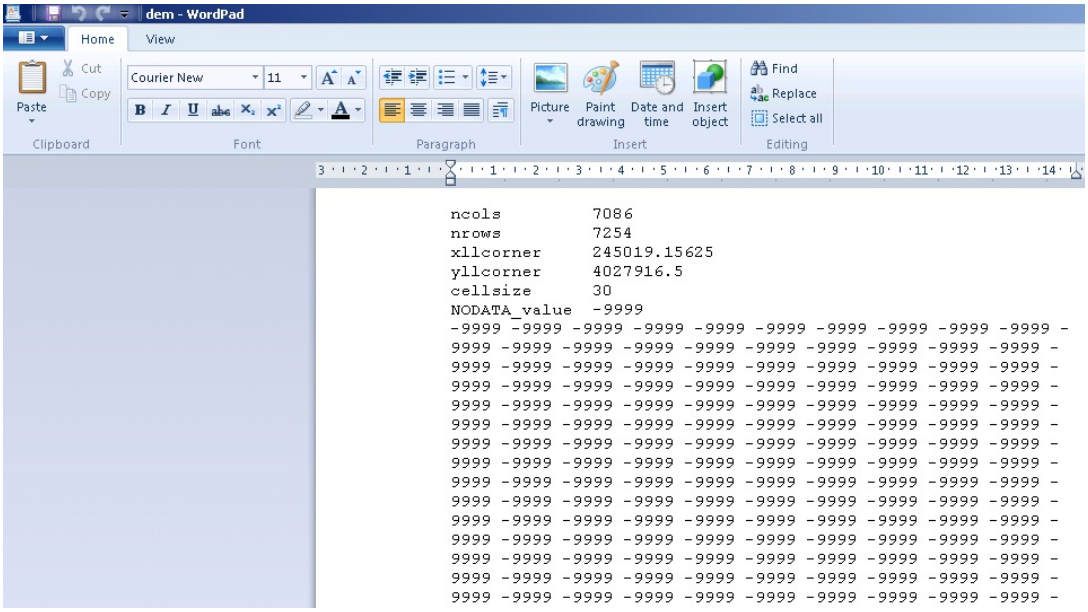

Illustration 27: ASCII File in World Pad

The ascii grid file in the header contains information about the size of the grid coverage. It contains the number of grid columns (ncols), the number of rows (nrows) the coordinates of lower left corner (xllcorner, yllcorner), the grid cell size (cellsize) and the no data value (NODATA_value). After the header the grid file body contains values for each cell.

Data downloading – Map (geo-tif format).

In SMS application users can download map files in georeference format and the appropriate legend. With this files user can create maps in reports or use the information in any GIS system. In both cases user must follow the following steps:

- Open a windows explorer and navigate to the download folder.
- Open dem_map.zip.
- Open Legend.html

Map in Report.

User can use any image viewer or image processing software to view the image file or even in a word processing software. In an image viewer coordinates stored in the

georeference file will not provide any spatial information. Legend can be opened in any browser. Legend is stored in vector html format. User can magnify legend without any loss of detail. In the example below a map in word pad is shown. User can incorporate map information in any report or document.

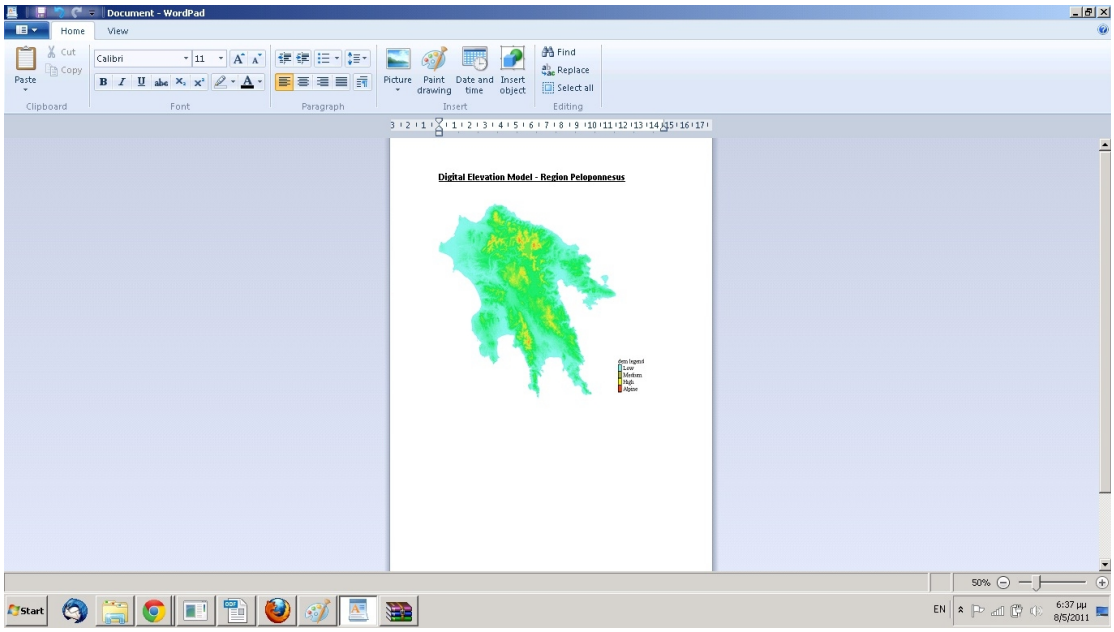

Illustration 28: Map in a report

Map in GIS.

User can import any map data in any GIS or CAD system since all map files have georeference. Coordinates and all relative metadata are stored in the Geo TIFF. In the following example a mapfile from region Peloponnesus is imported in ArcGIS.

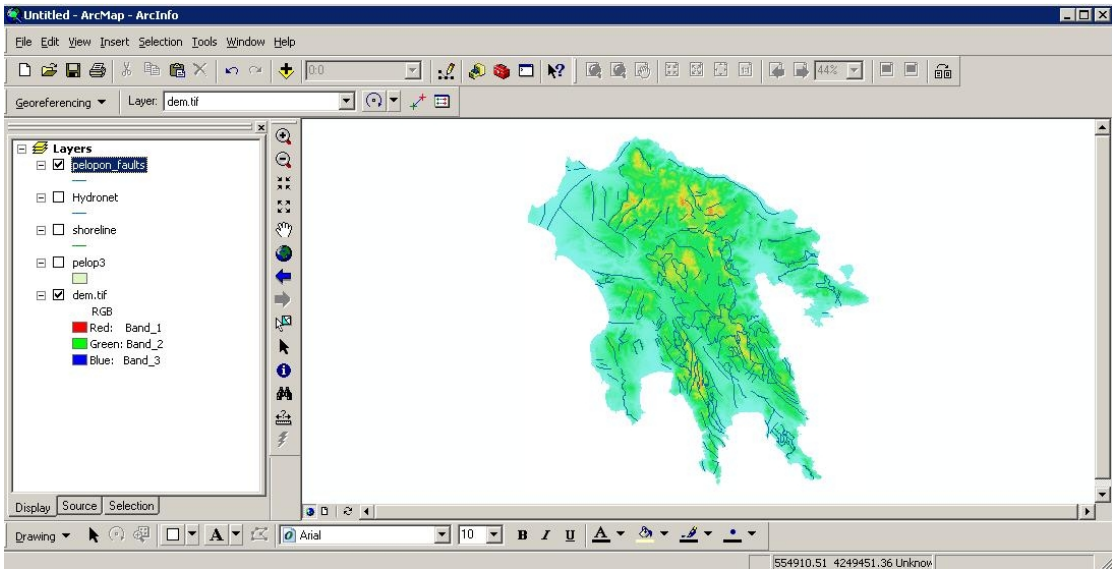

Illustration 29: Georeferenced layer in arc gis

GIS Modeling in SMS.

GIS Model building in SMS is a process of creating new GIS functions from existing functions by simulating a process. In SMS models are realized by writing Scripts. Scripts are simple text files that:

- Store commands in a text file that are then executed
- Can include “parameters” that allow a script to be used with many different layers or with different settings
- Scripts can be written SMS's model builder.

Before a user chooses a modeling method and start to work, there are a number of steps user should go through:

- The first, and most critical, is to determine what the OUTPUT of the modeling process should be
- Is there a need for spatially explicit, or spatially aggregated results (or both)?
  - Spatially Explicit – Result is a GIS data layer
    - E.g., Dissolving polygon boundaries to simplify the land cover classes in a data layer
  - Spatially Aggregated – Result is a number or a set of numbers
    - E.g., Calculating the total area of each habitat type in a given county
  - Spatially Explicit - What form should the final product(s) take?
    - Points, lines, routes or polygons?
  - Spatially Aggregated – What attributes are needed in the table(s)?

- After determining what the output should contain, identify the possible inputs
  - Layers containing needed attributes
  - Layers containing the needed points or polygons
  - Layers that can be used to produce the needed points or polygons
    - E.g., a point coverage that can be buffered to provide polygons

Raster map analysis

SMS application supports most of the raster functionality of GRASS GIS. GRASS is traditionally known for its powerful raster processing capabilities. All classical functionality plus time series data processing and models are available. While image processing command names differ in the first character (i.* instead of r.*), they are generally fully integrated in SMS application. Any image map (from an aerial camera or satellite) can be used as a normal raster map. Additional support is available to handle multispectral maps. More sophisticated methods such as orthophoto generation and image classication are supported as well.
Through GRASS, SMS supports pixelwise operations on raster maps as well as focal (neighborhood) and global (full map) calculations. Also buffers, watersheds, of lines, slope, aspect and curvature maps can be created, and raster algebra can be performed.

SMS Model Interface.

In the Location tab under the Model tab there are two sections. The Model List and the Model Upload Form. In the next section examples of SMS scripting will be demonstrated.

Digital elevation model (DEM) analysis

In SMS user can calculate slope and aspect from a DEM with r.slope.aspect command. First user resets the current region settings to those of the input map, then calculates slope and aspect:

command	***explanation***	***link***
g.region rast=dem -p	Area definition	http://grass.fbk.eu/gdp/html_grass64/g.region.html
r.slope.aspect el=dem as=aspect_30m sl=slope_30m	Parameter calculation	http://grass.fbk.eu/gdp/html_grass64/r.slope.aspect.html

In the above table the two commands that will be used in the model are demonstrated. In the ***Model Upload Form*** user can write in each line a command. At the top user must provide a unique name for the model.

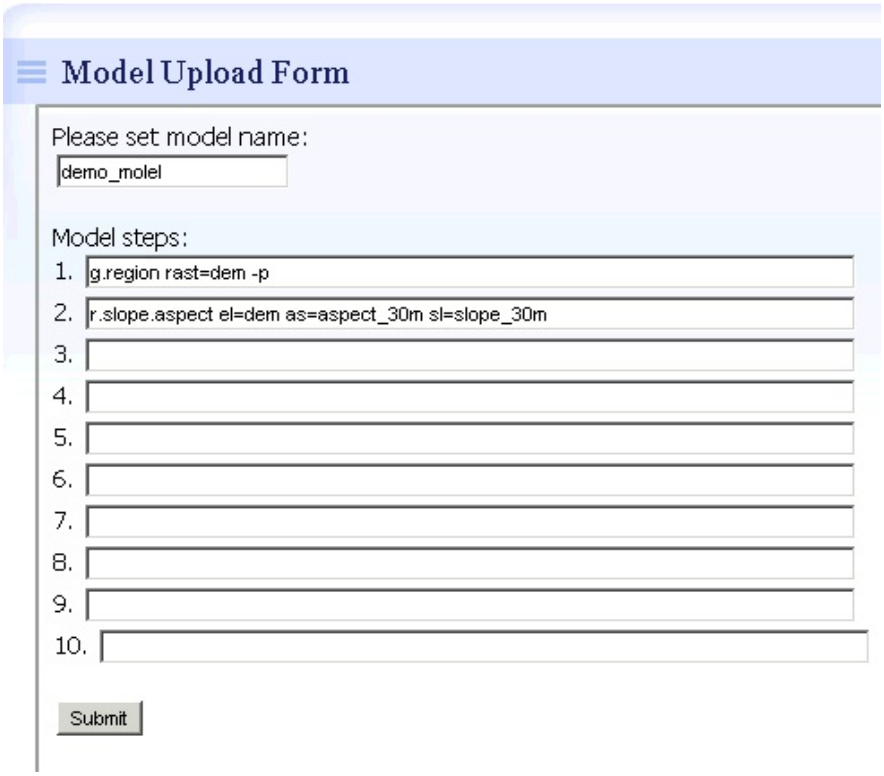

Illustration 30: Model Upload Form

Both maps are calculated in one step. Note that horizontal angles are counted counterclockwise from the East. Slopes are calculated by default in degrees.

Illustration 31: Model List Section - Available Models

User from the Model List can view the model and/or can execute (run) the model. The results are found in the Layers section under Location tab.

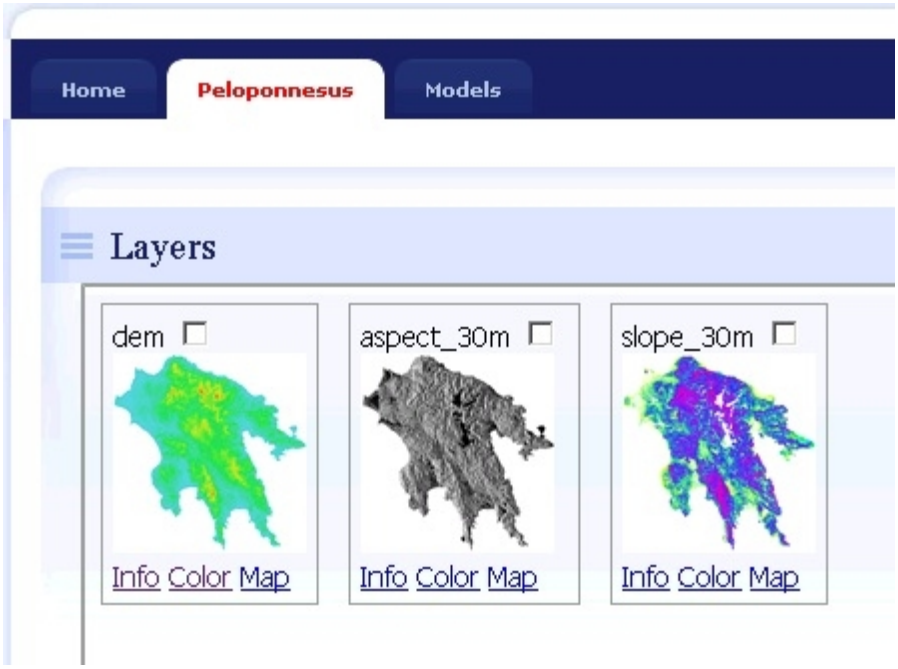

Illustration 32: Model results in Layer Browser

There are additional commands which work with DEMs: depression areas can be filled with r.fill.dir, and flowlines calculated with r.flow. Watershed analysis can be done with r.watershed and, on massive grids, with r.terraflow. For more information please visit:

http://grass.fbk.eu/gdp/html_grass64/full_index.html

Model help file

For every model user can attach a help file (pdf, jpg, txt, etc). By selecting *select file* user can navigate to the folder where the help file is stored and upload it and attache it to the model.

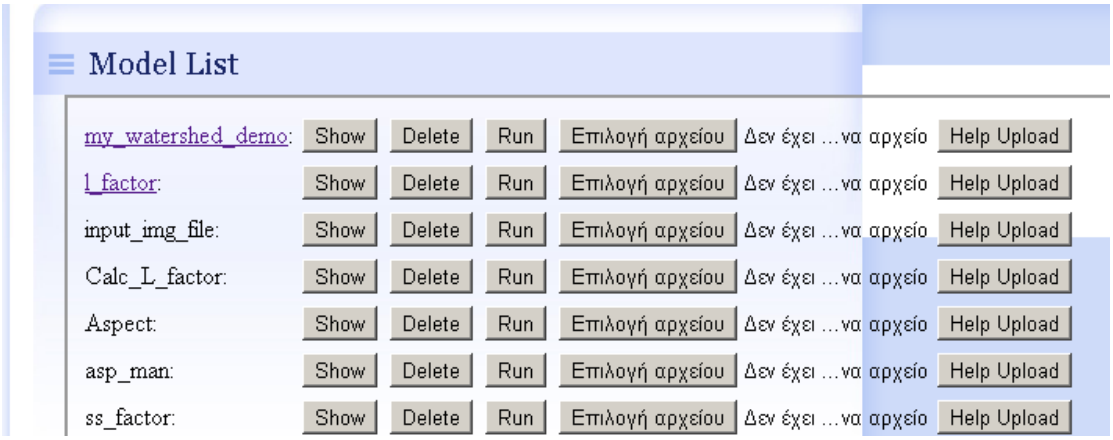

Illustration 33: Help file upload

Raster map algebra

SMS through GRASS provides the very powerful map calculator r.mapcalc. This module is best used on the model builder as there you have flexible cursor support provided by the shell. It operates cell by cell, using a moving window technology.
To start with some simple operations, an example is provided to filter all pixels with elevation higher than 1000m from the Peloponessus DEM in a model:

r.mapcalc "elev_1000 = if(dem > 1000.0, dem, null())"

In the Model Upload Form user can write in the command in a single line. At the top user must provide a name for the model.

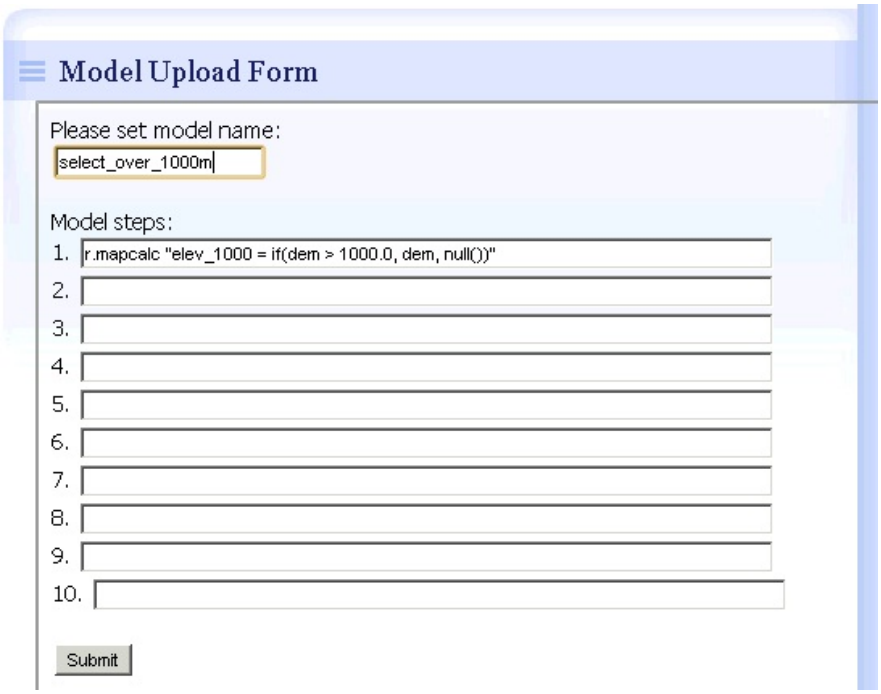

Illustration 34: Writing a model in Model Upload Form

The command, embedded in double quotes, contains an .if. statement (if higher than 1000m) with a .then. option (copy the pixel values) and an .else. option (write No Data if the condition is not satisfied). The null() function is a reserved word which inserts a No Data value for the actual raster cell being processed. There are a couple of further functions available such as mean(), min(), max(), sin(), cos() etc. The map calculator can accept more than one input map. New maps can be generated from calculations performed on a set of input maps. Additionally adjacent values can be considered, e.g. to generate ow through a landscape.

Illustration 35: View Model in Model List

User from the Model List can view the model and can run the model. The results are found in the Layers section under Location tab.

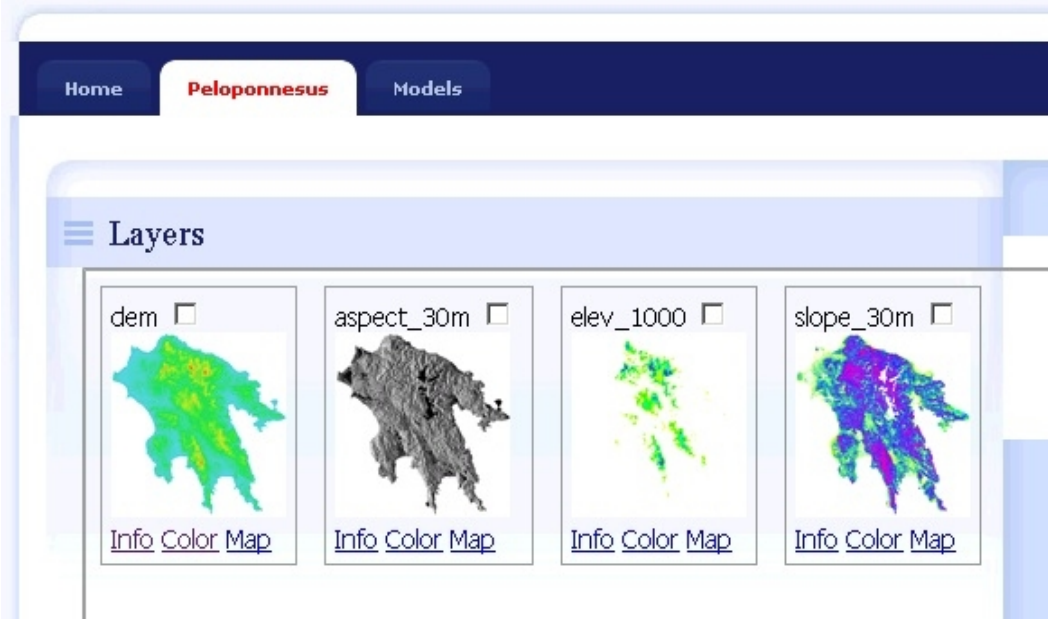

Illustration 36: Results In Layer Browser

Administrator Area

Metadata Configuration.

Metadata is a type of metadata that is applicable to objects that have an explicit or implicit geographic extent, in other words, are associated with some position on the surface of the Globe. Such objects may be stored in a geographic information system (GIS) or may simply be documents, datasets, images or other objects, services, or related items that exist in some other native environment but whose features may be appropriate to describe in a (geographic) metadata catalogue (may also be known as a data directory, data inventory, etc.).

Illustration 37: SMS administrator area

In SMS application Administrator has the ability to create metadata catalogs for raster or vector data sets. Simply administrator can add or remove fields from the metadata table.

Graphical Administrator Console.

SMS is the front end of a web application. Through the Admin tab, SMS administrator has access to the core application, Grass GIS. Only users with gis experience on grass gis software can have access to the server side component.

By selecting *Graphical Administrator Console* user can enter the server.

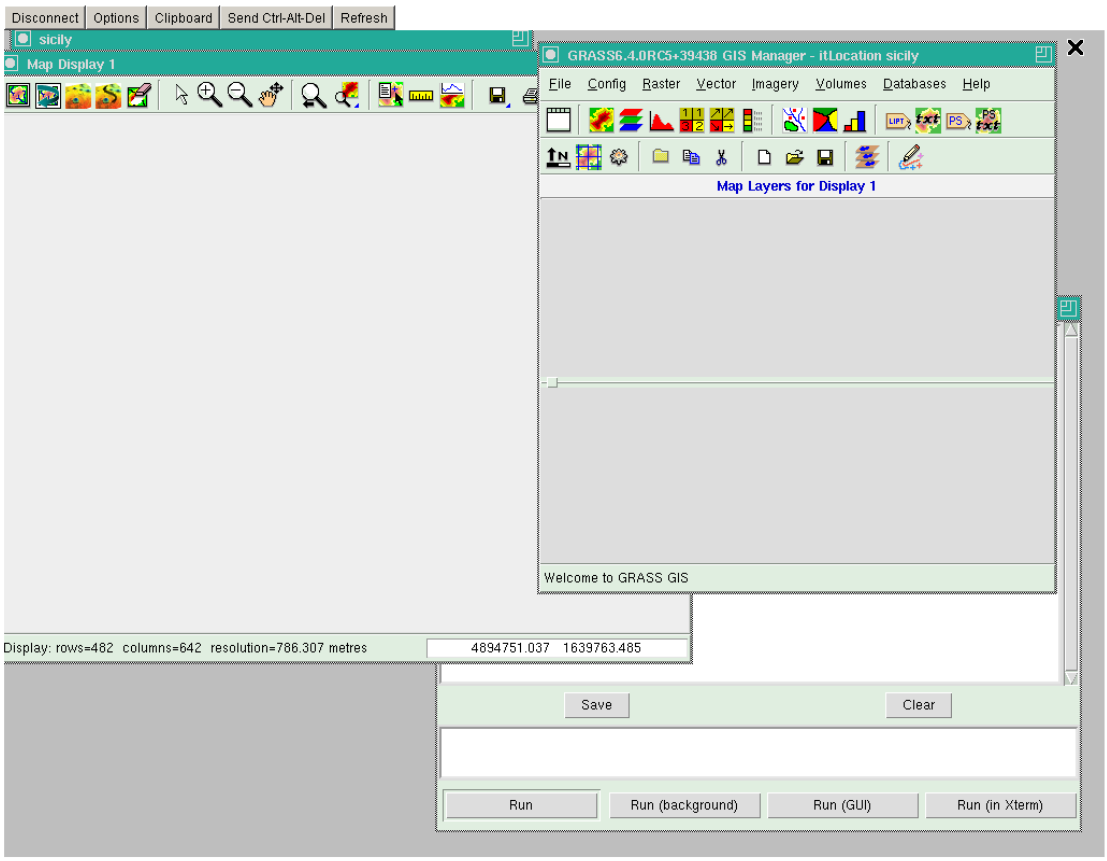

Illustration 38: Grass GIS server through SMS

Part B: Soil Management Models.

Need to be compiled.